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MARCH 7, 1882.

The President, Dr. LEIDY, in the chair.

Thirty-five persons present.

The death of Joseph Pancoast, M. D., was announced.

The Relation of Heat to the Sexes of Flowers.—Mr. THOMAS MEEHAN observed that the best fields for biological research were to be found amongst objects with which we have already a more or less familiar acquaintance. One fact observed will prove a stepping-stone to higher knowledge. His first new discoveries in *Acer dasycarpum*, the common silver maple of our streets, were communicated to the Academy and published in the Proceedings for 1868, and there had been interesting observations made on this species in the line of those discoveries on many occasions since that time. In that paper it was noted that the tree was not polygamous, as stated in the text-books, but strictly monœcious or diœcious. There were no hermaphrodite flowers, but each tree was either male or female, though occasionally the separate sexes were found on the same tree. The male flowers have no trace of a gynœcium, but the female flowers have well-formed anthers, but never have pollen, or even perfect themselves by lengthening filaments, as in the përfect male flower. Notwithstanding the perfect form of the anther, the stamens in the female are abortive. But the chief physiological fact of importance noted in the paper of 1868, was that a tree which for years would produce nothing but female flowers would sometimes change the sex, and bear only male flowers; while no instance could be found of a male tree eventually producing female-bearing branches. During the fourteen years since this discovery was recorded, Mr. Meehan said he had found frequent instances of change from female to male as at first observed, but not one instance of change from male to female. There could be no doubt of the order in which the sexual change occurred. While the maple was growing vigorously it followed the rule with all trees and made no attempt to flower. With some check to the vegetative force, the reproductive power asserted itself, and flowering began; this is the second stage. With a greater check to the vegetative force, only male flowers resulted. This was the third stage. Since that time he had shown to the Academy that when a maple-tree passed from the vegetative to the reproductive condition, and bore at once male flowers only, it was a leap down from the first to the third stage, missing the second or female—for he had found that though the amount of vital power exerted in the production of seeds, and the immense loss of leaves which the production of seed implied (as all know who are familiar with the silver maple after bearing a heavy crop of seeds), the female trees of the same age and under the same circumstances, were usually as large as the males which had no such strain on their nutritive powers.

He desired the members to pause here a few minutes, while he called their attention to another matter which he had recently brought to the notice of the Academy. It was in relation to the influence of heat on flower-buds. About the time of the fall of the leaf, there is little to distinguish a flower-bud from a leaf-bud. But the flower-bud continues to grow at a comparatively low temperature at which the leaf-bud remains stationary. Even when the thermometer was several degrees below the freezing point, flower-buds would increase in size, though naturally much more rapidly when above this line. In the peach, the growth of the flower-bud was very rapid between 32° and 40° Fahr., until by early spring they will have reached often as much as three-fourths larger in size. Indeed, a peach-bud will often have its flowers fully expanded before the leaf-bud has scarcely begun to grow. We learn from this lesson that it takes less heat to develop a flower-bud than a leaf-bud. In the light of these observations, he had been watching during the past winter the behavior of the buds on the silver maple. These advanced gradually until, by February 23, they commenced to expand—the leaf-buds remaining as they were at the fall of the leaf. They had been expanding continually as the days were warmer or colder, up to the present date (March 7), but the expanding blossoms have been wholly male flowers. Only to-day, as noted in the specimens exhibited, were the purple tips of the pistils visible through the parting bud-scales. It was obvious that here we had reached another important stage in the life history of the maple-tree. First, it requires less heat to induce growth in a maple flower-bud than a leaf-bud; secondly, it requires less heat to induce growth in the male flower than in the female.

Comparing the male with the female trees, Mr. Meehan noted differences in their habits of growth. Taking a twig of the last season's growth, in a flowering condition, one or two blossoms might appear alongside of the leaf-bud, in trees of either sex. So far we could find no difference. But in the female tree the central or leaf-bud, when it pushed into growth in the spring, made a shoot of several or many inches in length according to the vigor of the tree or parent branch. In the male tree, on the contrary, the central growth was not more than perhaps a quarter of an inch, forming a mere tuft of leaves on the top of what was a head of male flowers. In fact these branches were reduced to mere spurs, and weak spurs at that. He had measured these little branches or spurs which had been bearing male flowers for ten successive years, which were not more than from three to five inches in length, and not thicker than wheat straws. It was from these spurs that the great mass of opened flowers appeared. The male flowers on the shoots of last year did not advance as did the flowers on the spurs. It is very important to note this fact. These are only now opening, and are cotemporaneous with the opening of the female flowers which, like them, are sparsely arranged around the axillary bud of the past season. The immense amount of pollen from the early flowers, forming the great bulk of all the pollen produced by the tree, is scattered before the female flowers open, and is absolutely useless for any purpose of fertilization, or useless for any purpose of individual benefit to the tree or to the race, so far as we can see. These later-opening flowers, formed on the wood of last year, are evidently the chief reliance, if not the only reliance, of the female flower for its reproductive energy.

Just here an objection may be raised. If it be heat alone which advances the male flowers on the spurs, why does it not advance them on the wood of last year? If it take less heat to bring forward a male flower than a female flower, why is not this power exhibited when the separate flowers happen to be on branches both apparently alike in vital conditions? Here we may return to the point we diverged from. We have seen that there are successive stages from a high vegetative, but unproductive condition, to one of fertility; and again one lower than this, lower in comparison with vegetative power, in which the purely male or sterile condition is reached. In other words, a highly vital condition is more closely allied with those attributes which characterize the female sex than with those characteristic of the male, and we may therefore reasonably look for some influence in the female direction on the male flower where these conditions exist. Therefore male flowers on a shoot characterized by a highly vitalized condition, would be likely to resist influences to which they would be otherwise subjected. In short a male flower on a strong branch ought not to yield as readily to the excitement of heat as one growing on a weak branch. At any rate the fact that the whole of the weak spurs of the maple-tree produce nothing but male flowers, and that these male flowers expand at a lower temperature than the females do, is conclusive as to the law, whatever answer the objection may receive.

This law, thus demonstrated, will be of great practical value to culturists. So far as the single point of the advancement of the flowers by a low temperature is concerned, the peach-grower will be interested in keeping the temperature cool so that there shall be no advance of the flower until the temperature is high enough to bring forth the leaf-buds as well. Now we can go further and understand why some amentaceous plants so often produce no fruit or imperfect seeds. It is well known that isolated trees of birch, though producing abundance of male and female flowers, very often have not a perfect seed. We may now see how the catkins may be brought forward by a low temperature not sufficient to excite the female flowers, and thus lead them to mature and shed their pollen before the weather is warm enough to bring forward the female blossom to receive the necessary pollination. In seasons where the weather is cool till the regular springtime comes, or in climates where there is little very exciting warmth till the regular growing time arrives, there is not likely to be so great a period between the opening of the male and the female flowers. That this is the case with the common European hazel or filbert as grown in this country, an examination to-day clearly indicates. The catkins have attained their full length, and the anthers are ready to shed their pollen with another day's sun, but there is no sign yet of the little purple stigmas bursting through the scales of the buds which form the female flowers. Should the anthers disperse their pollen to-morrow, as they doubtless will if the temperature rises to 45°, there certainly can be no fertilization, and consequently no hazel-nuts from the trees in question next year. It was a well-known fact that the European hazel-nut often failed to bear nuts in this part of Pennsylvania, and we have clearly the explanation in the facts now developed. In Europe there were seldom such failures, the climate being probably favorable, more favorable to the simultaneous production of male and female flowers.

Mr. Meehan then briefly referred to the influence which these new facts must have on questions of dichogamy. There need not necessarily be any constant rule in the production of proterandrous or proterogynous flowers. We might expect to find proterandry prevailing to a greater extent in plants growing where there was a more constant succession of warm and cool days, than in the same species growing where the climate is not what is called changeable, that is to say, where the temperature was regularly low until the regular spring season had arrived, in which case there would not be much difference in time between the advance of stamens or pistils.

In conclusion he said, if he might be allowed to generalize from this experience with the maple-tree, the following principles seem proven:—

Male flowers do not appear on female maple-trees till some of its vital power has become exhausted.

Branch-buds bearing female flowers, have vital power sufficient to develop into branches.

Branch-buds bearing male flowers, have not vital power enough to develop into branches, but remain as spurs, which ever after produce male flowers only.

Buds producing male flowers only, are more excited by heat than females; and expand at a low temperature under which the females remain quiescent.

A few warm days, succeeded by cooler ones, will therefore make a corresponding difference in time between the opening of the male and the female flowers, and possibly in the proportionate advancement of the stamens and pistils in hermaphrodite flowers.

Professor **Heilprin** remarked that in the south of France there were often warm days in winter, much as we have here, but he believed there were no failures in the hazel-nut there.

Mr. Meehan said that when he used the word Europe, he had England in his mind, as his own personal experience was chiefly drawn from there. In that country, he believed, the catkins were never brought on by warm days in winter, so as to mature before there was warmth enough to develop the female flowers.

The President, Dr. **Joseph Leidy**, inquired whether the American species (*Corylus Americana*) exhibited the same characteristics as the English species ?

Mr. Meehan replied that he believed it would be found to do so, in some degree.

On Balanoglossus, etc.—Prof. **Leidy** stated that in a recent trip to Atlantic City, he had observed the singular worm, *Balanoglossus aurantiacus.* It occurs in moderate number along the shore of a pond between the beach and the lighthouse. In the same position he had collected *Solen ensis*, specimens of which were presented this evening. As this occurred in considerable number, he had procured a sufficient quantity to try it as an article of food, and had found it to make excellent soup. In the vicinity he had picked up a number of specimens of *Actinia rapiformis*, which had been recently thrown upon the beach. On a former occasion, at Atlantic City, he had observed another Actinia, the *Bicidium parasiticum*, which is parasitic on the large jelly-fish, *Cyanea arctica*, so frequently thrown on shore during the summer.

Scolithus in Gravel.—Prof. **Leidy** remarked, that since making the communication on some rock specimens, he had been led to suppose that if the quartzite pebbles of our gravels were largely derived from the Potsdam sandstone, the characteristic fossil, *Scolithus*, would be found as an occasional associate. With this view he had recently taken an opportunity of examining a gravel bank on the University ground, and had there picked up the three specimens exhibited, with well-marked *Scolithus*, which were broken from as many boulders. He also directed attention to specimens presented by Mr. John Ford. These consist of pebbles of a chalky white porous siliceous rock, with impressions of brachipod shells, which were picked up from the gravel of the reservoir at Fairmount Park.

MARCH 14.

The President, Dr. **Leidy**, in the chair.

Twenty-three persons present.